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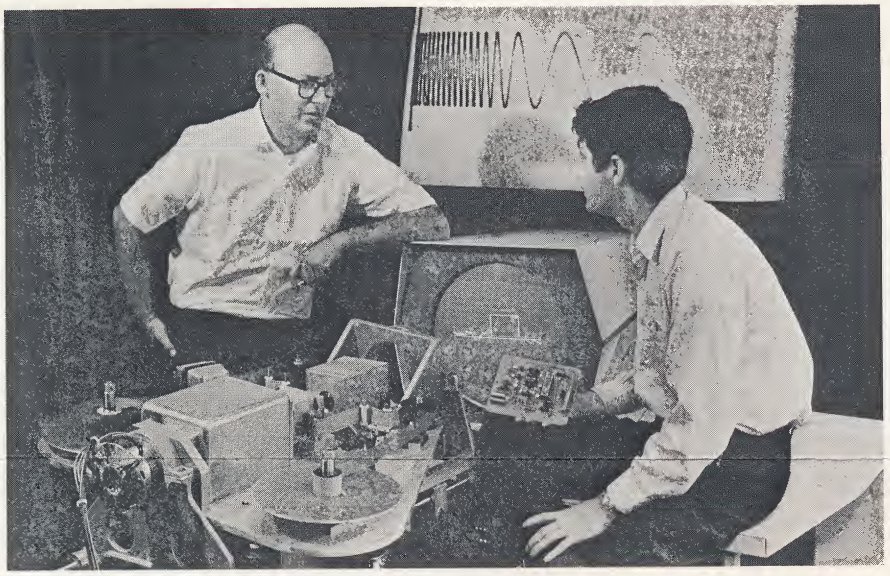

Edward Fredkin (right), head of Information International, Inc., consults with M. L. Minsky, company director and leader in artificial intelligence work at MIT.

NEW PRODUCTS

Eye for computers is quick as a wink

That, in essence, is the function of the Programmable Film Reader. For industry and the military, it does in a second what older equipment took a whole day to accomplish

The fleeting image traced by an electron beam on a radar screen can be captured on film, but the process of translating that film record into a form that can be fed into a computer has been about as slow as the electron beam is fast.

Now that situation is being changed by a new machine, whose heart lies in the reels and lens shown in front of the cathode ray tube (picture). What it does is remove a serious bottleneck from the process of transferring data ranging from blood cell counts to missile shots into a form that machines can use.

The device, called the Programmable Film Reader, can continuously read 5,000 points per second; previously, film reading devices were doing well if they read that many points in a whole day—and they needed the services of an operator. Laboratories have built a few extremely fast film readers for special purposes. One, at the University of California's Radiation Laboratory in Berkeley, reads bubble chamber tracks from film so fast that it is hooked directly to a very large scale computer. But the California machine is, so far, strictly one of a kind.

One-man show. The PFR is made by small but fast-growing Information International, Inc., of Cambridge, Mass. Just two and a half years ago, its 29-year-old president, Edward Fredkin, left a Boston programming company to open his one-man business. Already, he has parlayed his ideas into a company that cleared almost 10% on sales of $1-million in its second year. This year it's looking forward to sales of $4-million.

Most of the company's hopes are based on the PFR, which sells in a range from $100,000 up to nearly $300,000 and adds astronomical, medical, oceanographic, and biological film-reading to the military applications for which it was designed. Just the last three months, four machines have been ordered, valued at $1,350,000.

The company got into manufacturing quite by accident, after starting out to provide sophisticated programming services. MIT's Lincoln Laboratory needed to analyze miles of movie film from studies of missile tracking; it called on Information International for help.

Fredkin and his associates soon devised a system built around a rented movie camera. But they hacked up the camera so badly in the process that they had to buy it. And the end product, which had been intended merely as a feasibility demonstration, pleased the people at Lincoln so much that they wouldn't let it go.

Missile base. Soon after that, the Air Force heard about the machine and ordered a production model for its missile development center at Holloman Air Force Base, in New Mexico. Most subsequent orders have come from sophisticated customers who have seen the Holloman model. The latest and most accurate model can read high-density data from atomic test films to an accuracy of better than one-two thousandths of an inch.

The secret of the Programmable Film Reader is reflected in its name. It reads film with a light source that is directed by a computer. Thus it isn't necessary to scan the entire film; as Fredkin puts it: "We look at what's important and then follow it."

The computer program is crucial to the operation of the machine. And because Information International believes in a systems approach, it will not take an order for a reader unless it also supplies a program for the computer. "After we deliver the machine, the company can go ahead and write a different program," says Pres. Fredkin. "But at least we know that they have a setup that will work."

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NEWS RELEASE
FOR IMMEDIATE USE

FIRST AUTOMATIC FILM READER
INTRODUCED BY III

Maynard, Mass.---Delivery of the first fully automatic film reader has been made to Holloman Air Force Base, New Mexico, by Information International, Inc., specialists in automatic film reading equipment and services. The Air Force plans to use the new film reader for reading radar missile tracking data.

The PFR-1 or programmable film reader, according to III president Edward Fredkin rapidly scans and records large quantities of scientific data recorded on photographic film, and converts it to digital form on magnetic tape. Marking a technical advance in visual data processing, Mr. Fredkin commented that the PFR-1 makes it possible to take advantage of the great density film affords those who have massive scientific and engineering data to record, by providing a rapid means of assimilating this data. It is also important to note, said Fredkin, that film can record a wider bandwidth of information than any other medium---DC to 2,000 megacycles.

A number of applications in which III film reading equipment can or has already reduced information processing time to a minimum include:

- Ionisphere radar data
- Radio-astronomy radar data
- Meterological thunderstorm frequency data
- Oceanographic bathythermograph data
- Aircraft and missile theodolite data
- Spark and bubble chamber data
- Bacteriological and blood count data

Mr. Fredkin also commented that III has carried out a long testing period with the new equipment and has had considerable experiencein transcribing film data in a number of the above applications for such customers as the Woods Hole Oceanographic Institute and the Massachusetts Institute of Technology.

The PFR-1 system is based on three major elements: a PDP-1 digital computer together with a visual display scope; a film reading device; and computer programs for using the computer and film reader. The unit can read 16mm, 35mm, and 70mm film.

The film reading process involves the scanning of film by a rapidly moving light point on a visual display scope. The output of this scanning operation is detected by a photosensitive device in the film reader and is relayed to the digital computer for further processing and analysis. Various types of data output such as magnetic tape and printers are compatible with the PDP-1 computer.

The unit can read about 5,000 points of information per second as a continuous average, and is said to be about 1,000 times faster than any similiar purpose semi-automatic device now on the market. The speed of the automatic film reader can be compared to a skilled technician who can read and record manually only a single point of information every ten seconds.

The automatic system can read almost any kind of information that can be put on film. It can be programmed for reading lines, graphs, or points, and even mixed forms of data. The system also filters out extraneous information and noise, so that poor quality film can be read with great accuracy, often beyond the capacity of a human being.

In addition to translating film data into digital data, the system will provide summaries or analisis of the filmed materials at any time during the reading operation. Upon completion of a film reading problem, the computer can also be used in evaluating and analyzing the material it has assimilated.

Because photographic film is an inexpensive recording medium, has the highest storage capacity of information, the new PFR-1 makes using film economically feasible for the first time in the data processing field. Prices of the PFR system range from $94,000 to $267,000.

For further editorial information, please contact F.N. Karmatz.

EDP System Reads, Analyzes Data on Film

BY RAY CONNOLLY

MAYNARD, Mass. — A computer system for high-speed automatic reading and analysis of scientific data recorded on film has been developed by Information International, Inc., here.

The heart of the $267,000 system — the first of which has just been shipped to the AF Missile Development Center at Holloman AFB, Alamagordo, N. M.—is a programmable film reader, developed by the 18-month-old firm.

According to Edward Fredkin, president, the film reader is capable of reading up to 5000 points per second at a sustained average rate and, with the computer, print out data in digital form or record it on IBM-compatible magnetic tape. Data can also be presented visually, Mr. Fredkin said, taking the form of a continuous graph with the use of a digital X-Y plotter. Or it can be presented as still or motion photographs of scope displays, he said.

In addition to filmed data, the system can read data recorded on any light-permeable medium, such as light- or medium-weight paper.

Apart from the flexibility of the automatic system, Mr. Fredkin said its 5000-point-per-second reading rate is faster than the 5000-point-per-day possible with existing systems, which are only semi-automatic.

David Lovenvirth, technical director for the firm, said the film reader has an additional advantage, in that it is sensitive to changes in the film's photographic density. By employing complex logic, the system can disregard the capacity of a human operator. In such instances, however, the reading rate is slow, he acknowledged.

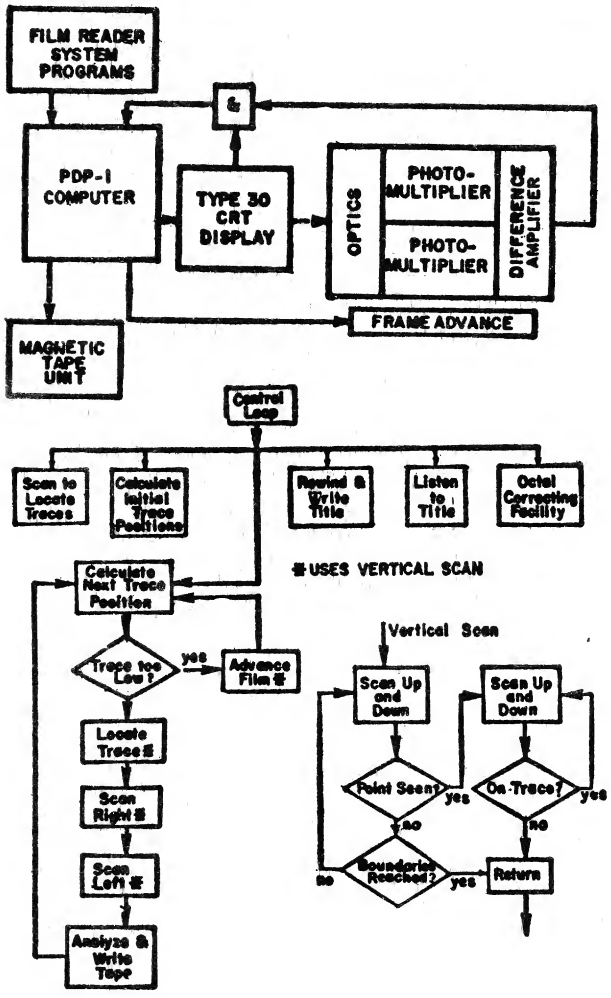
Multiple Uses — While the system is expected to have multiple applications, the first unit for the Air Force will be used in Project Defender, to read data recorded in the form of radar pulses on 35 mm film. Defender is one of a series of ballistic missile concepts under study by the Defense Department.

In reading ballistic-missile radar-tracking data, the film reader is said to be capable of producing 500 readings per frame of the amplitude of radar signals; computing the median amplitude value for each frame; counting the number of radar pulses; measuring the width of each pulse, its average amplitude during pulse and the location of the leading edge of each pulse, and finally, recording all original and processed data on magnetic tape.

The prototype was developed by the firm for Massachusetts Institute of Technology's Lincoln Laboratory, which is also involved in the Defender project.

In the Air Force system, two other major elements are used with the Information International film reader. These include a PDP-1 computer, built by Digital Equipment Corp., here, together with a visual display scope and computer programs for using the computer and film reader. However, Mr. Fredkin said, the film reader can be used with computers of other manufacturers.

The basic reader developed by the firm is priced at $94,000. It is made up of two parts: An optical and mechanical unit (OMU) and the signal processor and logic unit (SPLU).



EQUIPMENT LAYOUT: Information International's film reader system is outlined in the top diagram, while the control and scan program is shown below.

How It Works — Mr. Lovenvirth described the operation this way: A rapidly moving light point, on the face of the computer's cathode-tube display, is used to scan the film. Light coming from this point is divided into two beams by an optical beam splitter.

One beam passes through a lens and is focussed on the film, to be read on a corresponding specified location. Light transmitted through the film at this location goes through a collector lens, is defocussed and is sensed on the cathode of a photomultiplier tube. This signal is then amplified and its voltage measured.

For comparison, the other beam passes through a second lens along a different optical path — which does not include the film to be read — and is sensed on the cathode of a second photomultiplier. This signal, too, is amplified and its voltage measured.

The two signals are then passed through a difference amplifier to establish a comparison. The output is processed in accordance with wired-in logic circuits in the signal processor and logic unit, under the direction of an appropriate computer program.

Specifically, the SPLU determines whether the density of the image on the film at a given spot, and at peak time of illumination is greater or less than a given value. An appropriate signal is then sent to the computer, which is programmed for correct interpretation. These digitized results can then be stored on IBM-format magnetic tape.

Mr. Fredkin describes this as a one-bit decision, in which the SPLU takes the input from the optical-mechanical unit, measures density and decides whether the point is more or less dense than the given standard.

Circuit Protection — Circuits built into the SPLU protect the photomultiplier and other circuits in the OMU. This is done by disconnecting the high voltage if preset limits of current or voltage are exceeded, or if ambient light in the OMU cabinet, as measured by a photoresistor, is exceeded.

Film advance signals, controlled by the computer program, are also passed through the SPLU. The unit, in addition, provides indications to the computer of the status of equipment. While the computer itself does not set equipment controls, it does furnish typed information to the operator, who can set controls on both the SPLU and OMU.

The Digital Equipment Corp. PDP-1 computer, used in the Air Force system, is a high-speed, solid-state digital unit, designed to operate with multiple forms of input-output devices with no internal machine changes. A single-address stored-program computer, it consists of four equipment frames, one of which is the operating station. The entire unit occupies 17 square feet of floor space.

The 16-inch display scope used in the system also was developed by DEC. In addition to random point plotting at a rate of 40,000 points per second, the Type 30 tube is said to have an accuracy of points ±3 per cent of its raster size, which is 9⅜x9⅜ inches and contains 1024x1024 points. Resolution of the tube is such that at least 512 points along each axis of X-Y coordinates are discernible on the tube face.

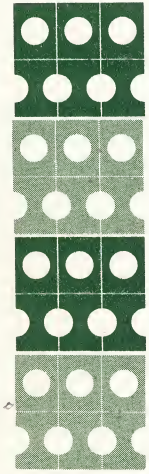
Film Reading Programs — Two major programs are used by the computer in the film reading system. These include (1) control and scan and (2) data analysis. In addition to these, however, is a display program to check results of analysis with artificially introduced data.

In the radar trace system, this data can be introduced by drawing sample radar-like traces on the scope with a light pen. The program will then display the results of the data analysis. By this technique, the display program will assist in setting analysis parameters that best match the range of anticipated values.

Information International, a privately held firm employing 18, will post annual sales of $1 million when it closes its second fiscal year next month, according to Mr. Fredkin. He estimates profit for the year will fall between $50,000 and $100,000. However, with the perfection of the film reader, he expects sales to expand as the system finds other markets.

Other Applications — In addition to tracking and analysis of objects such as ballistic missiles for which motion picture film is available, the company believes this system will find applications in analysis of data produced by oscillographs or other types of graphic recorders; reading of astronomical or astrophysical data, such as steller configurations; reading photographs of cloud, spark or bubble chambers, and as a particle counter using photographs of bacteria or blood cells.

The firm already has developed a system similar to the Air Force unit which reads data recorded on film by oceanographic current meters.



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